UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,922	10/01/2003	David E. Lowell	200309154-1	8294

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EXAMINER
WAI, ERIC CHARLES

ART UNIT	PAPER NUMBER
2195	

NOTIFICATION DATE	DELIVERY MODE
04/15/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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	Application No.	Applicant(s)
Office Action Summary	10/676,922	LOWELL, DAVID E.
	Examiner	Art Unit	
	ERIC C. WAI	2195	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on <u>09 January 2009</u>.

2a) ☐ This action is **FINAL**.   2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) <u>1-66</u> is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) <u>1-66</u> is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a) ☐ All b) ☐ Some * c) ☐ None of:

      1. ☐ Certified copies of the priority documents have been received.

      2. ☐ Certified copies of the priority documents have been received in Application No. _____.

      3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date <u>01/22/2009</u>.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____

U.S. Patent and Trademark Office

PTOL-326 (Rev. 08-06)   **Office Action Summary**   Part of Paper No./Mail Date 20090401

DETAILED ACTION

1.   Claims 1-66 are presented for examination.

2.   In view of the Appeal Brief filed on **01/09/2009**, PROSECUTION IS HEREBY

REOPENED. A new ground of rejection is set forth below.

3.   To avoid abandonment of the application, appellant must exercise one of the

following two options:

        (1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply

under 37 CFR 1.113 (if this Office action is final); or,

        (2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed

by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and

appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth

in 37 CFR 41.20 have been increased since they were previously paid, then appellant

must pay the difference between the increased fees and the amount previously paid.

4.   A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by

signing below.

Double Patenting

5.   The nonstatutory double patenting rejection is based on a judicially created
doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the
unjustified or improper timewise extension of the "right to exclude" granted by a patent
and to prevent possible harassment by multiple assignees.   A nonstatutory
obviousness-type double patenting rejection is appropriate where the conflicting claims
are not identical, but at least one examined application claim is not patentably distinct

from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.2d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

6.   Claims 1-66 are provisionally rejected on the ground of nonstatutory

obviousness-type double patenting as being unpatentable over claims 1-67 of

copending Application No. 10/677,159. Although the conflicting claims are not identical,

they are not patentably distinct from each other. For example, claim 1 of the present

application recites, "a method comprising to commence virtualization of the I/O device at

runtime". Claim 1 of copending Application No. '159 recites "the method comprising

commencing virtualization of the memory at runtime". It would have been obvious to one

of ordinary skill in the art that an I/O device can be a memory.

This is a <u>provisional</u> obviousness-type double patenting rejection because the

conflicting claims have not in fact been patented.

7.   Claims 1-66 are provisionally rejected on the ground of nonstatutory

obviousness-type double patenting as being unpatentable over claims 1-72 of

copending Application No. 10/676,557. Although the conflicting claims are not identical,

they are not patentably distinct from each other. For example, claim 1 of the present application recites, "a method comprising to commence virtualization of the I/O device at runtime". Claim 1 of copending Application No. '557 recites "the method comprising interposing the virtual machine monitor between the computer and the operating system at runtime". It would have been obvious to one of ordinary skill in the art that interposing the virtual machine monitor at runtime is equivalent to commencing virtualization using a virtual machine.

This is a <u>provisional</u> obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Claim Rejections - 35 USC § 112

8.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9.   Claim 3 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

      a.   The following terms lack antecedent basis in the claims:

            i.   Claim 3, "the operating system".

Claim Rejections - 35 USC § 102

10.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11.   Claims 1-8,10,12-14,16-19, 25-26, 28-34, 36-38, 44, 46-51, 53-57, 61, 63, and

65-66 are rejected under 35 U.S.C. 102(e) as being anticipated by Nelson et al. (US Pat

No. 6,961,941).

12.   Regarding claim 1, Nelson teaches a computer including an I/O device (col 3 line

29), a method comprising using a virtual machine monitor to commence virtualization of

the I/O device at runtime (col 3 lines 5-16, 29-40, 48-53, wherein after a commodity

operating system (COS) is first loaded and initialized, *then* a kernel containing the VMM

is then loaded (i.e. at runtime) via the COS; "after *initialization* of the computer, a list of

devices *initially* controlled by the COS is preferably transferred from the COS to the

kernel", i.e. the device is virtualized).

13.   Regarding claim 2, Nelson teaches that the computer further includes a CPU (col

1 lines 52-54), wherein the virtual machine monitor is in control of the CPU prior to the

runtime virtualization of the I/O device (col 3 lines 29-40, wherein the kernel must be in control of the CPU in order to virtualize the device).

14.   Regarding claim 3, Nelson teaches that the virtualization is performed transparently to the operating system (col 1 lines 38-41).

15.   Regarding claim 4, Nelson teaches that the I/O device is compatible with the virtualized I/O device (col 1 lines 38-51, wherein they must be compatible in order for the virtualization to be transparent).

16.   Regarding claim 5, Nelson teaches that the virtualization includes commencing I/O device emulation at runtime (col 3 lines 5-16, 29-40, 48-53, wherein after a commodity operating system (COS) is first loaded and initialized, *then* a kernel containing the VMM is then loaded (i.e. at runtime) via the COS; "after *initialization* of the computer, a list of devices *initially* controlled by the COS is preferably transferred from the COS to the kernel", i.e. the device is virtualized).

17.   Regarding claim 6, Nelson teaches configuring the hardware to trap I/O accesses, and enabling the virtual machine monitor to emulate the I/O device in response to the traps (col 3 lines 37-40, wherein the VMM must trap I/O access to emulate delivery of the interrupt; wherein interrupts are generated by I/O devices).

18.   Regarding claim 7, Nelson teaches that the virtual machine monitor uses
memory management to trap the I/O accesses (col 4 lines 20-22).

19.   Regarding claim 8, Nelson teaches that the virtual machine monitor can
commence the emulation between I/O sequences (col 3 lines 44-47, wherein the VMM
emulates operation for the physical resources whenever VMs require such resources).

20.   Regarding claim 10, Nelson teaches that the virtual machine monitor can
commence the emulation in the middle of an I/O sequence (col 3 lines 44-47, wherein
the VMM emulates operation for the physical resources whenever VMs require such
resources).

21.   Regarding claim 12, Nelson teaches that the runtime virtualization includes using
the virtual machine monitor to emulate I/O device interrupts (col 3 lines 44-47, wherein
interrupts are masked; wherein interrupts are generated by I/O devices).

22.   Regarding claim 13, Nelson teaches that the I/O device interrupts are directed to
the operating system prior to the runtime virtualization of the I/O device (col 3 lines 29-
31, wherein the devices are initially controlled by the COS before being transferred to
the kernel).

23.   Regarding claim 14, Nelson teaches that the virtual machine monitor temporarily
pauses an I/O sequence by emulating the I/O device as being busy (col 3 lines 41-43,
wherein interrupts are delayed).

24.   Regarding claim 16, Nelson teaches devirtualizing the I/O device at runtime
following the runtime virtualization (col 5 lines 22-25).

25.   Regarding claim 17, Nelson teaches a computer including hardware, a virtual
machine monitor running on the hardware, an operating system running on the virtual
machine monitor, the hardware including an I/O device, the I/O device already
virtualized by the virtual machine monitor, a method comprising devirtualizing the I/O
device at runtime (col 5 lines 18-25, wherein control is transferred from the kernel (i.e.
devirtualizing the system), and the first operating system takes over).

26.   Regarding claim 18, Nelson teaches that the devirtualization is performed
transparently to the operating system (col 1 lines 38-41).

27.   Regarding claim 19, Nelson teaches that the devirtualization includes stopping
I/O device emulation at runtime (col 5 lines 18-25, wherein the VMM no longer handles
the interrupts).

28.   Regarding claim 25, Nelson teaches re-directing interrupts from interrupt

handlers in the virtual machine monitor to interrupt handlers in the operating system (col

5 line 20).

29.   Regarding claim 26, Nelson teaches configuring the hardware so the accesses

by the operating system to the I/O device no longer trap to the virtual machine monitor

(col 5 lines 18-25).

30.   Regarding claim 28, Nelson teaches that the I/O device is virtualized at runtime

again after having been devirtualized at runtime (col 5 lines 8-17).

31.   Regarding claims 29-34, 36-38, 44, and 46, they are the computer claims of

claims 1, 4-7, 10, 12, 14, 17, 26, and 28 above. Therefore they are rejected for the

same reasons as claims 1, 4-7, 10, 12, 14, 17, 26, and 28 above.

32.   Regarding claims 47-51, 53-57, 61, 63, and 65-66, they are the article claims of

claims 1, 5-7, 10, 12, 14, 17, 19, 26, and 28 above. Therefore they are rejected for the

same reasons as claims 1, 5-7, 10, 12, 14, 17, 19, 26, and 28 above.

Claim Rejections - 35 USC § 103

33.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

34.   Claims 9, 11, 15, 20-24, 27, 35, 39-43, 45, 52, 58-62, and 64 are rejected under

35 U.S.C. 103(a) as being unpatentable over Nelson et al. (US Pat No. 6,961,941).

35.   Regarding claim 9, Nelson teaches that the virtual machine monitor commences

emulation by intercepting I/O accesses (col 3 lines 44-47).

36.   Nelson does not teach that the virtual machine monitor uses the intercepted I/O

accesses to change the state of a state machine, whereby the state machine reflects

the state of the I/O device; and wherein the virtual machine monitor examines

transitions in the state of the state machine to determine whether the I/O device is in the

middle of an I/O sequence.

37.   It would have been obvious to one of ordinary skill in the art at the time of the

invention to include the use of a state machine. One would be motivated by the desire

to have a method of representing the state of the I/O device to track its operation.

38.   Regarding claim 11, Nelson does not teach that the virtual machine monitor uses

a state machine to determine whether the I/O device is in the middle of an I/O

sequence, and delays commencing emulation until the state machine indicates that I/O sequence has completed.

39.   It would have been obvious to one of ordinary skill in the art at the time of the invention to include the use of a state machine. One would be motivated by the desire to have a method of representing the state of the I/O device to track its operation. It also would have been obvious to delay commencing emulation. One would be motivated by the desire to not interrupt the I/O sequence.

40.   Regarding claim 15, Nelson does not teach that the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing virtualization; and wherein the virtual machine monitor restores the determined mode of the operation after virtualization.

41.   It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been obvious to restore a previous mode of operation after virtualization. One would be motivated by the desire to ensure that the virtualization proceeded transparently.

42.   Regarding claim 20, Nelson does not teach that the devirtualization includes allowing the virtual machine monitor to temporarily stop the operating system from commencing a new I/O sequence.

43.   It would have been obvious to one of ordinary skill in the art at the time of the invention to include temporarily stopping the OS from commencing a new I/O sequence.

One would be motivated by the desire to ensure complete devirtualization before processing a new I/O request.

44.   Regarding claim 21, Nelson teaches that the virtual machine monitor temporarily stops the operating system by emulating the I/O device as being in a "busy" or "device not ready" state (col 3 lines 41-47, wherein the interrupt controller interface logic masks all interrupts preventing delivery).

45.   Regarding claim 22, Nelson does not teach that the virtual machine monitor bounds the amount of time the operating system processing is temporarily stopped.

46.   It would have been obvious to one of ordinary skill in the art at the time of the invention that the VMM bound the amount of time that the OS is stopped. One would be motivated by the desire to ensure that the OS not be stopped indefinitely.

47.   Regarding claim 23, Nelson does not teach that the VMM logs I/O accesses by the operating system to the I/O device during devirtualization, and replays the log to the device after devirtualization, whereby the I/O accesses by the operating system are deferred during the devirtualization of the I/O device.

48.   It would have been obvious to one of ordinary skill in the art at the time of the invention to that some sort or logging and playback must occur when the device is devirtualized. One would be motivated by the desire to track any requests that main occur during devirtualization.

49.   Regarding claim 24, Nelson does not teach that the virtual machine monitor waits for I/Os initiated by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation.

50.   It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Nelson to wait for I/Os initiation by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation. One would be motivated by the desire to ensure that all interrupts directed to the VMM are completed before transferring control.

51.   Regarding claim 27, Nelson does not teach wherein the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing devirtualization; and wherein the virtual machine monitor restores the determined mode of the operation after devirtualization.

52.   It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been obvious to restore a previous mode of operation after devirtualization. One would be motivated by the desire to ensure that the devirtualization proceeded transparently.

53.   Regarding claims 35, 39-43, and 45, they are the computer claims of claims 11,
20-24, and 27 above. Therefore they are rejected for the same reasons as claims 11,
20-24, and 27 above.

54.   Regarding claims 52, 58-62, and 64, they are the article claims of claims 11, 20-
24, and 27 above. Therefore they are rejected for the same reasons as claims 11, 20-
24, and 27 above.

Response to Arguments

55.   Applicant's arguments with respect to claims 1-66 have been considered but are
moot in view of the new ground(s) of rejection.

Conclusion

56.   Any inquiry concerning this communication or earlier communications from the
examiner should be directed to Eric C. Wai whose telephone number is 571-270-1012.
The examiner can normally be reached on Mon-Thurs, 8am-5pm.

        If attempts to reach the examiner by telephone are unsuccessful, the examiner's
supervisor, Meng - Ai An can be reached on 571-272-3756. The fax phone number for
the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

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USPTO Customer Service Representative or access to the automated information

system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VAN H NGUYEN/   /Eric C Wai/
Primary Examiner, Art Unit 2194   Examiner, Art Unit 2195

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